

---

# ModBus RTU communication protocol for THT sensors

---

Complete protocol description

---



# MODBUS RTU for THT

## Datasheet

Created: 6.4.2009

Translated: 3.6 2011 10:34

Total pages: 16

© 2011 Papouch s.r.o.

---

## Papouch s.r.o.

Address:

**Strasnicka 3164  
102 00 Prague 10  
Czech Republic**

Tel:

**+420 267 314 267  
+420 267 314 268  
+420 602 379 954**

Fax:

**+420 267 314 269**

Internet:

**[www.papouch.com](http://www.papouch.com)**

E-mail:

**[info@papouch.com](mailto:info@papouch.com)**



**TABLE OF CONTENTS**

Description.....	4
Basic communication parameters .....	4
Firmware change log .....	4
Switching the protocols .....	5
Spinel → ModBus RTU.....	5
Allow configuration.....	5
Switching .....	5
MODBUS RTU → Spinel .....	5
Memory Layout .....	6
Holding Register.....	6
Input Register.....	6
Detailed information about instructions .....	7
Communication parameters.....	7
Allow configuration.....	7
Device's address .....	7
Serial line communication speed.....	8
Data word format .....	9
Packet end distinction .....	9
Communication protocol .....	10
Quantities.....	11
Values and current states of channels .....	11
Channels' states .....	12
Measured-out value – signed integer .....	12
Measured-out value – decimal number .....	13
Measured-out value – RAW value from ADC .....	13

**DESCRIPTION**

This document describes ModBus RTU communication protocol embedded into an intelligent sensor for temperature and humidity, THT. Datasheet and manual can be both downloaded from <http://www.papouch.com/> in PDF format.

**Basic communication parameters**

---

- Communication line.....RS485
- Communication speed .....from 1.2 kBd to 115.2 kBd (default: 9.6 kBd)
- Data bits.....8
- Parity.....no parity
- Stop bits .....1
- Delay before response is sent.....2 ms<sup>1</sup>
- Default address.....0x31
- Default protocol.....Spinel

**Firmware change log**

---

**Version 04**

ModBus RTU protocol added. THT is capable of communication via one protocol at once. Active protocol can be set by special instruction described below. (Default protocol is Spinel described in other document.)

---

<sup>1</sup> Delay is added in order to allow the device to switch the direction of RS485 communication.

## SWITCHING THE PROTOCOLS

Default communication protocol is Spinel. For switching the protocol to ModBus RTU, following Spinel instruction must be sent to the device.

### Spinel → ModBus RTU

#### Allow configuration

This instruction allows service instructions. It has to forego the switching instruction.

Instruction cannot be used with universal or broadcast address.

#### Request:

*Instruction code: E4H*

#### Response:

*Acknowledge code: ACK 00H*

#### Examples:

<b>Request:</b>
2AH, 61H, 00H, 05H, 01H, 02H, E4H, 88H, 0DH
Allow configuration.
<b>Response:</b>
2AH, 61H, 00H, 05H, 01H, 02H, 00H, 6CH, 0DH
Instruction acknowledged.

#### Switching

Switching the protocol is executed by special Spinel 97 instruction. Address of a specific module has to be used (the instruction cannot be used with universal or broadcast address.) Allow configuration instruction must forego this instruction.

#### Request:

*Instruction code: EDH*

#### Response:

*Acknowledge code: ACK 00H*

#### Examples:

<b>Request:</b>
2AH, 61H, 00H, 06H, 66H, 02H, EDH, 02H, 17H, 0DH
Switching instruction: Spinel to ModBus RTU.
<b>Response:</b>
2AH, 61H, 00H, 05H, 66H, 02H, 00H, 07H, 0DH
Instruction acknowledged. From this point on THT communicates via ModBus RTU.

### MODBUS RTU → Spinel

The way to switch is documented on page 10 of this document.

**MEMORY LAYOUT**

**Holding Register**

<i>Address</i>	<i>Access</i>	<i>Function</i>	<i>Designation</i>	<i>Page</i>
<b>Communication parameters</b>				
0x0000	read, write	0x03, 0x06, 0x10	Allow configuration	5
0x0001	read, write	0x03, 0x06, 0x10	Address (ID)	7
0x0002	read, write	0x03, 0x06, 0x10	Communication speed	8
0x0003	read, write	0x03, 0x06, 0x10	Data word	9
0x0004	read, write	0x03, 0x06, 0x10	Packet end distinction	9
0x0005	read, write	0x03, 0x06, 0x10	Communication protocol	10

**Input Register**

<i>Address</i>	<i>Access</i>	<i>Function</i>	<i>Designation</i>	<i>Page</i>
<b>Values and states of channels – ordered by number of channel</b>				
0x0000	read	0x04	Temperature – Status	12
0x0001	read	0x04	Temperature – Signed integer value	12
0x0002	read	0x04	Temperature – Float value (3. and 2. byte)	13
0x0003	read	0x04	Temperature – Float value (1. and 0. byte)	13
0x0004	read	0x04	Humidity – Status	12
0x0005	read	0x04	Humidity – Signed integer value	12
0x0006	read	0x04	Humidity – Float value (3. and 2. byte)	13
0x0007	read	0x04	Humidity – Float value (1. and 0. byte)	13
0x0008	read	0x04	Dew point – Status	12
0x0009	read	0x04	Dew point – Signed integer value	12
0x000A	read	0x04	Dew point – Float value (3. and 2. byte)	13
0x000B	read	0x04	Dew point – Float value (1. and 0. byte)	13
<b>Values and states of channels – ordered by type</b>				
0x001D	read	0x04	Temperature – Status	12
0x001E	read	0x04	Humidity – Status	12
0x001F	read	0x04	Dew point – Status	12
0x0020	read	0x04	Temperature – Signed integer value	12
0x0021	read	0x04	Humidity – Signed integer value	12
0x0022	read	0x04	Dew point – Signed integer value	12
0x0023	read	0x04	Temperature – Float value (3. and 2. byte)	13
0x0024	read	0x04	Temperature – Float value (1. and 0. byte)	13
0x0025	read	0x04	Humidity – Float value (3. and 2. byte)	13
0x0026	read	0x04	Humidity – Float value (1. and 0. byte)	13
0x0027	read	0x04	Dew point – Float value (3. and 2. byte)	13
0x0028	read	0x04	Dew point – Float value (1. and 0. byte)	13
0x0029	read	0x04	Temperature – RAW value	13
0x002A	read	0x04	Humidity – RAW value	13

## DETAILED INFORMATION ABOUT INSTRUCTIONS

### Communication parameters

#### Allow configuration

This instruction has to forego all instructions that write into the holding register. It is in place to protect the device against unwanted changes in configuration.

Allow Configuration has to forego every configuration instruction. It is not allowed to write by Multiple write Allow configuration and other parameters.

#### Function codes:

0x03 – Read Holding register

0x06 – Write Single Register

0x10 – Write Multiple registers

#### Memory position and length:

Starting Address	2 Bytes	0x0000
Register count	2 Bytes	1

#### Parameters:

Number of bytes	1 Byte	2
Result	2 Byte	0x00FF = allow configuration accepted

#### Device's address

It is the address (ID) of the device. There have to be devices with unique addresses on the same communication bus. The address explicitly identifies the device on bus. Default address is 0x31.

#### Function codes:

0x03 – Read Holding register

0x06 – Write Single Register

0x10 – Write Multiple registers

#### Memory position and length:

Starting address	2 Bytes	0x0001
Register count	2 Bytes	1

#### Parameters:

Number of bytes	1 Byte	2
Address	2 Byte	Address of the device from 1 to 247

**Serial line communication speed**

Configures the speed of RS485 line.

**Function codes:**

0x03 – Read Holding register

0x06 – Write Single Register

0x10 – Write Multiple registers

Memory position and length:

Starting address	2 Bytes	0x0002
Register count	2 Bytes	1

**Parameters:**

Number of bytes	1 Byte	2
Speed code	2 Byte	Speed code: 1200 - 0003H 2400 - 0004H 4800 - 0005H 9600 - 0006H ( <i>default settings</i> ) 19200 - 0007H 38400 - 0008H 57600 - 0009H 115200 - 000AH



**Data word format**

This instruction configures parameters of the data word (parity, data bits and stop bits).

**Function codes:**

0x03 – Read Holding register

0x06 – Write Single Register

0x10 – Write Multiple registers

Memory position and length:

Starting address	2 Bytes	0x0003
Register count	2 Bytes	1

**Parameters:**

Number of bytes	1 Byte	2
Speed code	2 Byte	Code according to the table below. (Default is 0x0000.)

Code	Data bits	Parity	Stop bits
0x0000 (default)	8	none (N)	1
0x0001	8	even (E)	1
0x0002	8	odd (O)	1
0x0003	8	none (N)	2
0x0004	8	even (E)	2
0x0005	8	odd (O)	2
0x0006 to 0x00FF	8	none (N)	1

**Packet end distinction**

Configures what delay between bits is considered an end of the packet. Delay is entered as bit count. You can enter 4 to 100 bits. Default value is 10.

**Function codes:**

0x03 – Read Holding register

0x06 – Write Single Register

0x10 – Write Multiple registers

Memory position and length:

Starting address	2 Bytes	0x0004
Register count	2 Bytes	1

**Parameters:**

Number of bytes	1 Byte	2
Delay	2 Byte	Delay as a bit count. You can enter 4 to 100 bits.

**Communication protocol**

This instruction allows THT to be switched to Spinel protocol. After sending the response, THT switches to Spinel protocol and communicates with it from this point on.

**Function codes:**

0x03 – Read Holding register

0x06 – Write Single Register

0x10 – Write Multiple registers

**Memory position and length:**

Starting address	2 Bytes	0x0005
Register count	2 Bytes	1

**Parameters:**

Number of bytes	1 Byte	2
Protocol code	2 Byte	Protocol code: Spinel - 0001H MODBUS RTU - 0002H

## Quantities

### Values and current states of channels

This is how you read measured-out values from THT. Returns values as an integer and also recalculated as a decimal number (32bit float according to IEEE 754).

Values are sent in two formats at once. As a signed integer (16bit value) multiplied by a factor of ten (i.e. temperature 24.6°C is sent as 256). Or as a recalculated decimal number in 32bit float format according to IEEE 754<sup>2</sup>.

In this area values are ordered by channels in the memory. In following areas they are ordered by type.

#### Function codes:

0x04 – Read Input register

Memory position and length:

Starting address	2 Bytes	Temperature: 0x0000 Humidity: 0x0004 Dew point: 0x0008
Register count	2 Bytes	3

#### Parameters:

Number of bytes	1 Byte	8
Status	2 Byte	0x0000 – value is valid and within range 0x0001 – value not yet available 0x0002 – upper limit exceeded Other values – other error
Value INT	2 Byte	Measured-out value. Signed integer.
Float value	4 Byte	Measured-out value. 32 bit float according to IEEE 754

<sup>2</sup> Description of IEEE 754 standard is available here: [http://en.wikipedia.org/wiki/IEEE\\_754](http://en.wikipedia.org/wiki/IEEE_754)

**Channels' states**

This way all states of all quantities in THT can be read.

**Function codes:**

0x04 – Read Input register

Memory position and length:

Starting address	2 Bytes	Temperature: 0x001D Humidity: 0x001E Dew point: 0x001F
Register count	2 Bytes	3

**Parameters:**

Number of bytes	1 Byte	2
Status	2 Byte	0x0000 – value is valid and within range 0x0001 – value not yet available 0x0002 – upper limit exceeded Other values – other error

**Measured-out value – signed integer**

All values can be read from THT at once, in this case as signed integer (16bit value) multiplied by a factor of ten (i.e. temperature 24.6°C is sent as 256).

**Function codes:**

0x04 – Read Input register

Memory position and length:

Starting address	2 Bytes	Temperature: 0x0020 Humidity: 0x0021 Dew point: 0x0022
Register count	2 Bytes	3

**Parameters:**

Number of bytes	1 Byte	2
Value INT	2 Byte	Measured-out value as signed integer

**Measured-out value – decimal number**

All values can be read from THT as 32 bit float numbers according to IEEE 754.

**Function codes:**

0x04 – Read Input register

Memory position and length:

Starting address	2 Bytes	Temperature: 0x0023 Humidity: 0x0025 Dew point: 0x0027
Register count	2 Bytes	6

**Parameters:**

Number of bytes	1 Byte	4
Float value	4 Byte	According to value. 32 bit float according to IEEE 754.

**Measured-out value – RAW value from ADC**

You can also get all values directly from internal A/D converter without any conversion. Values are 16bit numbers directly from A/D converter. (RAW value of the dew point is not available as it is calculated from temperature and humidity.)

**Function codes:**

0x04 – Read Input register

Memory position and length:

Starting address	2 Bytes	Temperature: 0x0029 Humidity: 0x002A
Register count	2 Bytes	2

**Parameters:**

Number of bytes	1 Byte	2
Float value	2 Byte	Measured-out 16bit value from A/D converter.





# Papouch s.r.o.

Data transmission in industry, line and protocol conversions, RS232/485/422/USB/Ethernet/GPRS/WiFi, measurement modules, intelligent temperature sensors, I/O modules, and custom-made electronic applications.

Address:

**Strasnicka 3164  
102 00 Prague 10  
Czech Republic**

Tel:

**+420 267 314 267  
+420 267 314 268  
+420 602 379 954**

Fax:

**+420 267 314 269**

Internet:

**[www.papouch.com](http://www.papouch.com)**

E-mail:

**[info@papouch.com](mailto:info@papouch.com)**

